

What is claimed:

1. A slurry used in a chemical mechanical polishing (CMP) process, the slurry comprising:

ceric ammonium nitrate  $[(\text{NH}_4)_2\text{Ce}(\text{NO}_3)_6]$ .

5

2. The slurry according to claim 1 further comprising an abrasive and an acid.

3. The slurry according to claim 2, wherein the ceric ammonium nitrate is present in an amount ranging from about 1 to about 10% by weight of the slurry.

4. The slurry according to claim 2, wherein the acid is selected from the group consisting of  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{H}_3\text{PO}_4$ , and mixtures thereof.

15

5. The slurry according to claim 2, wherein the acid is  $\text{HNO}_3$  and is present in an amount ranging from about 1 to about 10% by weight of the slurry.

6. The slurry according to claim 2, wherein the abrasive is selected from the group consisting of  $\text{CeO}_2$ ,  $\text{ZrO}_2$ ,  $\text{Al}_2\text{O}_3$  and mixtures thereof.

7. The slurry according to claim 2, wherein a grain size of the abrasive is less than 1  $\mu\text{m}$ .

25 8. The slurry according to claim 2, wherein the abrasive is used in an amount ranging from about 1 to about 5% by weight of the slurry.

9. The slurry according to claim 2, wherein a pH of the composition ranges from about 1 to about 7.

10. The slurry according to claim 2, wherein the pH of the composition 5 ranges from about 1 to about 3.

11. The slurry according to claim 2, further comprising a buffer.

12. The slurry according to claim 11, wherein the buffer comprises a 10 mixed solution of approximately equal molar amounts of an organic acid and an organic acid salt.

13. The slurry according to claim 12, wherein the buffer comprises a mixed solution of acetic acid and acetic acid salt.

15

14. A method for forming a ruthenium pattern, the method comprising:  
(a) preparing a semiconductor substrate where a ruthenium film or ruthenium alloy film is formed; and  
(b) patterning the ruthenium film or ruthenium alloy film using a CMP  
20 process using the slurry of claim 2.

15. The method according to claim 14, wherein step (b) is performed with a polishing pressure ranging from about 1 to about 3 psi.

16. The method according to claim 14, wherein step (b) is performed by using a rotary type CMP system, and a table revolution number ranges from about 10 to about 80 rpm.

5 17. The method according to claim 14, wherein step (b) is performed in a linear type CMP system where a table movement speed ranges from about 100 to about 600 fpm.

10 18. A method for manufacturing a semiconductor device, the method comprising:

(a) sequentially stacking an interlayer insulating film and silicon nitride on a semiconductor substrate having a predetermined lower structure that comprises a capacitor contact region;

15 (b) forming a contact hole by exposing the capacitor contact region of the substrate by performing a photolithography process on the structure produced in step (a);

(c) forming a contact plug in the contact hole;

(d) stacking a sacrificial insulating film on the structure formed in steps (a) through (c);

20 (e) forming a sacrificial insulating film pattern by exposing the contact plug by patterning the sacrificial insulating film;

(f) depositing a ruthenium film on the structure formed in steps (a) through (e);

25 (g) forming a sacrificial photoresist film pattern by coating a sacrificial photoresist film on the structure formed in steps (a) through (f) and performing a CMP process using the ruthenium film as an etch barrier film; and

(h) forming a lower electrode by patterning the ruthenium film by performing a CMP process using the sacrificial insulating film pattern as an etch barrier film on the structure formed in steps (a) through (g) by using the CMP slurry composition of claim 2.

5

19. The method according to claim 18, wherein the contact plug comprises stacked layers of polysilicon,  $\text{TiSi}_2$  and  $\text{TiAlN}$ .

10 20. The method according to claim 18, wherein the sacrificial insulating film is selected from the group consisting of an oxide film and an oxide nitride film.

15 21. The method according to claim 18, wherein the sacrificial insulating film pattern is removed after step (h), and a dielectric film and an upper electrode are sequentially formed on the resultant structure.

22. The method according to claim 21, wherein the dielectric film is a  $(\text{Ba}_{1-x}\text{Sr}_x)\text{TiO}_3$  film.

20 23. A semiconductor device manufactured according to a method of claim 18.